PLODIA INTERPUNCTELLA (HUBNER) (PHYCITIDAE : LEPIDOPTERA) AS A POTENTIAL PEST OF DRY FRUITS[1]

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Key words: *Plodia interpunctella*, dry fruits, susceptibility, weight loss, development period, moisture content

Relative susceptibility of 12 types of dry fruits *viz.*, almond, apricot, cashewnut, chilgoza, coconut, date, fig, hazelnut, mulberry, pista, raisin and walnut and 10 varieties of pista procured from Iran i.e. Ebrahimi, Fandoghi, Gholam Rezaia, Jabbary, Kallenghoochi, Momtaz, O'hadi, Rezaia, Shasti and Wahedi to the attack of *Plodia interpunctella* (H.) has been studied for the first time.The results showed that cashewnut and pista were the most susceptible and date the least. Out of 10 pista varieties, the varieties Rezaia and Wahedi were the most resistant while the cultivars Fandoghi and Momtaz were the most susceptible. The index of susceptibility has been calculated on the basis of weight loss of fruits and development period and progeny of the pest.

Introduction

The Indian meal moth *Plodia interpunctella* (Hubner) (Phycitidae : Lepidoptera) is an important pest of stored cereals, legumes and dry fruits. The damage is caused by the larvae: besides consuming the product they also spoil it with their webbings and faecal matter, making it unfit for human consumption. A large number of studies have been made on its general biology. Hoppe (1981), Mbata (1987, 1990) and Stein (1990) studied the development pattern while food preference was studied by Lecato (1976). Observations on oviposition behaviour have been made by Mullen and Arbogast (1977), Mbata (1985, 1990) and Almasi *et al.*, (1987). Grant (1974), Grant and Brady (1975) and Grant (1976) studied the copulation while Grant (1974), Grant and Brady (1975), Ono (1981) and Rangaswamy (1985) made observations on the role of pheromones. The diapause behaviour has been studied by Bell and Walker (1973) and Bell (1976a, 1976b). However, only a few dry fruits have been tested as hosts of this pest. Myers (1928) studied the relative preference of the pest for a few dry fruits. Hamlin *et al.*, (1931), Simmons (1931) and William (1964) observed development in some dry fruits and cereals. Mullen and Arbogast (1977) studied oviposition on peanuts and dates while Mbata and Osuji (1983) studied the development in whole and cracked groundnuts.

The present communication deals with the relative susceptibility and extent of damage to 12 dry fruits and 10 varieties of pista, to assess the potential of *P. interpunctella* (Hubner) as a pest of stored dry fruit.

Material and Methods

Adults of *Plodia interpunctella* (H.) used in the present study were taken from stock cultures raised in the laboratory from small samples collected from Delhi and Chandigarh. The cultures were maintained on different foods stored in an electric incubator fixed at 30 ± 1° C and 75-85% R.H. The foods used for stock cultures as well as those selected for different experiments were sterilized at 50° C for two hours in order to eliminate any parasites or other microorganisms. The twelve selected dry fruits were *Prunus amygdalus* Batsch almond, *Prunus armeniaca* L. apricot, *Anacardium occidentale* L. cashewnut, *Pinus gerardiana* chilgoza, *Cocos nucifera* L. coconut, *Phoenix dactylifera* L. date, *Ficus glomerata* fig, *Corylus* spp. hazelnut, *Morus nigra* L. mulberry, *Pistacia vera* L. pista, *Vitis vinifera* L. raisin and *Juglans regia* L. walnut. The susceptibility index of different dry

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fruits was studied out by keeping ten three-day old eggs mixed with 2 gm of nuts. Three replications were kept in each case.

The samples were reweighed after emergence to determine the loss of weight due to consumption by the larvae. The moisture content of the samples was also calculated at the beginning and the end of the experiment and loss/ increase in weight due to moisture variation was considered while calculating actual weight loss.

The percentage weight loss due to moisture content variations has been calculated by using the following relationship given by Jamieson (1970).

$$G = \frac{100\,(M_2 - M_1)}{100 - M_2}$$

Where M_1 = Initial moisture content percentage wet basis.

M_2 = Final moisture content percentage wet basis.

Knowing the value of G, the loss or gain in weight due to variation in moisture content (d) can be calculated as under, and necessary correction in weight loss of the food made.

$$d = \frac{G \times W_1}{100}$$

Where W_1 = Observed weight loss of the food.

G = Loss or gain percentage in weight due to moisture content variation.

The data obtained were subjected to statistical analysis.

Results and Discussion

The relative susceptibility of twelve types of dry fruits was calculated on the basis of food consumed, the number of adults emerged, duration of developmental period and weight loss of the fruits.

The results given in Table 1 showed that amount of different foods consumed by the larvae varied greatly, the largest amount being consumed in mulberry (1.816 gm) and the least in the case of coconut (0.004 gm).

Appreciable differences have also been noted in the average development period. Pista registered the shortest development period of 31.71 days, whereas, date showed the longest development period of 104.25 days. However, Hamlin *et al.* (1931) observed more rapid development of larvae on figs among three fruits namely raisins, prunes and figs tested by them. The progeny produced was maximum in pista, walnut, cashewnut and almond, while other fruits produced comparatively much less progeny. The

Table 1

WEIGHT LOSS OF 12 DRY FRUITS DUE TO THE ATTACK OF *PLODIA INTERPUNCTELLA* (H.)

(based on three observations)

Food	Initial Weight of food mean (gm)	Final Weight of food mean (gm)	Moisture Content M_1	Moisture Content M_2	Weight loss	Mean % age weight loss	Corrected mean % age weight loss
Mulberry	2	0.184	8.96	7.326	1.816	90.80	90.768
Fig	2	0.593	10.32	9.949	1.407	70.35	70.345
Cashewnut	2	1.149	4.38	3.307	0.851	42.55	42.541
Almond	2	1.248	3.82	3.410	0.752	37.60	37.597
Walnut	2	1.449	3.40	2.208	0.551	27.55	27.544
Pista	2	1.485	3.34	2.828	0.515	25.75	25.748
Raisin	2	1.497	12.12	6.479	0.503	25.15	25.120
Hazelnut	2	1.550	3.46	2.387	0.450	22.50	22.496
Date	2	1.713	9.26	7.764	0.287	14.35	14.346
Apricot	2	1.862	17.54	14.607	0.138	6.90	6.896
Coconut	2	1.996	2.98	2.550	0.004	0.20	0.200
Chilgoza	2	Nil	Nil	Nil	Nil	Nil	Nil

larvae failed to survive on apricot, coconut and chilgoza as they do not get sufficient nutrition to reach maturity. In fact, the larvae did consume some food in the case of apricot and coconut but died before reaching the pupal stage. In the case of chilgoza, on the contrary, the larvae did not consume any food.

The relative suitability of different foods was also determined with the help of the formula Log eY/T, given by Osuji (1976), where Y is the number of progeny, T is the time taken by 50% of the adults to emerge and e is a constant with a value of 2.303 (Table 2). Pista, walnut and hazelnut, with a suitability index value of 1.743, 1.590 and 1.393, were the most suitable food while date with an index value of 0.085 was the least suitable food.

The relative susceptibility of various foods can be judged by combining the amount of food consumed with the index of suitability (Table 3). Cashewnut and pista with susceptibility index values of 49.773 and 44.878 respectively, were the most susceptible foods whereas date with the index value of 1.219 was the least susceptible food.

TABLE 2
RELATIVE SUITABILITY OF 12 DRY FRUITS TO THE ATTACK BY *PLODIA INTERPUNCTELLA* (H.)

(based on three replications of 10 eggs each)

Food	Progeny Y	(Average) Development period (T_{50} days)	Index of suitability $Log_e Y/T_{50}$
Pista	24	31.71	1.743
Walnut	25	36.20	1.590
Hazelnut	21	34.71	1.393
Cashewnut	25	49.20	1.170
Almond	24	49.04	1.127
Mulberry	14	81.21	0.397
Fig	8	101.38	0.181
Raisin	5	94.60	0.121
Date	4	104.25	0.085
Apricot	Nil	Nil	Nil
Coconut	Nil	Nil	Nil
Chilgoza	Nil	Nil	Nil

Log_e = 2.303 (constant)
T_{50} = Time taken by 50% of the adults to emerge.

It is clear from the data in Tables 2 and 3 that the order of relative suitability and relative susceptibility of the foods was different. This is so because cashewnut undergoes maximum weight loss though the development period on this food is long. It is the duration of the development period that pushes the cashewnut at number 4 in term of suitability index. However, maximum weight loss by cashewnut pushes its susceptibility index to number 1. There is little difference in the two indices of pista and date which occupy the same order in the lists of both indices.

TABLE 3
RELATIVE SUSCEPTIBILITY OF 12 DRY FRUITS TO THE ATTACK BY *PLODIA INTERPUNCTELLA* (H.)

Food	Suitability index value (a)	Corrected mean % age of weight loss (b)	Susceptibility index value (axb)
Cashewnut	1.170	42.541	49.773
Pista	1.743	25.748	44.879
Walnut	1.590	27.544	43.795
Almond	1.127	37.597	42.372
Mulberry	0.397	90.768	36.035
Hazelnut	1.393	22.496	31.337
Fig	0.181	70.345	12.732
Raisin	0.121	25.120	3.039
Date	0.085	14.346	1.219
Apricot	Nil	6.896	Nil
Coconut	Nil	0.200	Nil
Chilgoza	Nil	Nil	Nil

The resistance among ten cultivars of pista procured from Tehran Agriculture University was tested on the same pattern as followed for different fruits and susceptibility index was calculated in the same manner. The obtained results are give in Tables 4, 5 and 6.

Table 4 reveals that varieties 'GH' and 'WA' underwent a minimum weight loss of 0.439 gm and 0.465 gm respectively whereas, 'MO' underwent a maximum weight loss of 0.660 gm.

The progeny from 30 eggs on each food varied from 20 to 28 and the developmental period differed from 22.5 to 26.83 days (Table 5).

TABLE 4
WEIGHT LOSS OF TEN VARIETIES OF PISTA DUE TO THE ATTACK OF *PLODIA INTERPUNCTELLA* (H.)

(based on three observations)

Food	Initial Weight of food mean (gm)	Final Weight of food mean (gm)	Moisture Content M_1	Moisture Content M_2	Weight loss	Mean % age weight loss	Corrected mean % age weight loss
'MO'	2	1.340	4.380	4.029	0.660	33.000	32.998
'FA'	2	1.363	4.600	4.400	0.637	31.850	31.849
'KA'	2	1.406	4.420	4.196	0.594	29.700	29.699
'JA'	2	1.431	4.160	3.913	0.569	28.450	28.449
'EB'	2	1.433	4.100	3.698	0.567	28.350	28.348
'SH'	2	1.471	4.620	4.554	0.529	26.450	26.449
'OH'	2	1.498	4.680	4.270	0.502	25.100	25.098
'RE'	2	1.524	4.480	3.608	0.476	23.800	23.796
'WA'	2	1.535	4.360	3.452	0.465	23.250	23.246
'GH'	2	1.561	4.520	4.290	0.439	21.950	21.949

MO = Momtaz FA = Fandoghi KA = Kallehghoochi JA = Jabbary EB = Ebrahimi
SH = Shasti OH = O'hadi RE = Rezaia WA = Wahedi GH = Gholam Rezaia

It is clear from the susceptibility index results (Table 6), that the varieties 'FA' and 'MO' with the susceptibility index values of 84.750 and 77.578 were the most susceptible foods while the varieties 'RE' and 'WA' with the index value of 41.119 and 45.887, were the least susceptible foods.

The result of this study reveal that dry fruits like cashewnut, pista, walnut, almond, hazelnut and mulberry are preferred foods of *Plodia interpunctella* (Hubner) and therefore special care should be taken to save these commodities from the attack of this pest. The damage to fig and raisin is not much and therefore, no special care is required for protection of these two fruits. The remaining three fruits namely apricot, coconut and chilgoza are not attacked by the pest in nature. Some larval feeding is witnessed on apricot and

TABLE 5
RELATIVE SUITABILITY OF TEN VARIETIES OF PISTA TO THE ATTACK BY *PLODIA INTERPUNCTELLA* (H.)

(based on three replications of 10 eggs each)

Food	Progeny Y	(Average) Development period (T_{50} days)	Index of suitability $Log_e Y/T_{50}$
'FA'	26	22.50	2.661
'O'H'	28	25.64	2.514
'GH'	26	24.23	2.471
'KA'	27	25.48	2. 440
'MO'	25	24.48	2.351
'JA'	26	25.65	2.334
'SH'	25	25.12	2.291
'EB'	22	23.77	2.131
'WA'	23	26.83	1.974
'RE'	20	26.65	1.728

Log_e = 2.303 (constant)
T_{50} = Time taken by 50% of the adults to emerge.

TABLE 6
RELATIVE SUSCEPTIBILITY OF TEN VARIETIES OF PISTA TO THE ATTACK BY *PLODIA INTERPUNCTELLA* (H.)

Food	Suitability index value (a)	Corrected mean % age of weight loss (b)	Susceptibility index value (axb)
'FA'	2.661	31.849	84. 750
'MO'	2 .351	32.998	77. 578
'KA'	2.440	29.699	72.465
'JA'	2.334	28.449	66. 400
'O'H'	2.514	25.098	63. 096
'SH'	2.291	26.449	60.594
'EB'	2.131	28.348	60. 409
'GH'	2.471	21.949	54. 235
'WA'	1.974	23.246	45. 887
'RE'	1.728	23.796	41.119

coconut under experimental conditions, whereas no feeding takes place in case of chilgoza.

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